Title: Winning Is the Sweetest Reward!

Brief Overview:

Middle school students are very competitive and when given the chance will work to increase their odds of winning. In this simulation, students will work independently to record and organize chance data based on the number of candy bars sold.

Links to NCTM 2000 Standards:

- **Mathematics as Problem Solving, Reasoning and Proof, Communication, Connections, and Representation**
  These five process standards are threads that integrate throughout the unit, although they may not be specifically addressed in the unit. They emphasize the need to help students develop the processes that are the major means for doing mathematics, thinking about mathematics, understanding mathematics, and communicating mathematics.

- **Number and Operation**
  Students will record the results of the candy bar sales by renaming fractions, decimals, and percents in equivalent forms.

- **Patterns, Functions and Algebra**
  Using graphs and tables, students will generalize patterns and relationships from the organized data.

- **Geometry and Spatial Sense**
  Students will calculate the degrees in central angles based on each individual probability.

- **Data Analysis, Statistics and Probability**
  The calculation of dependent and independent events will be made by students in order to make predictions. Additionally, students will construct and interpret circle graphs.

Links to National Science Education Standards:

- **Unifying Concepts and Processes**
  Students will organize data in order to complete charts and graphs.

- **Science as Inquiry**
  Using reasoning and interpretation, students will draw and make predictions about the outcomes of the raffle.

- **Science and Technology**
  Students may use calculators to compute data and graph outcomes and solve problems using arithmetic operations.

Grade/Level:

Grades 7 – 9 or adaptive high school education.

Duration/Length:

Two to three days.

Prerequisite Knowledge:

Students should have a working knowledge of the following skills:

- Fraction, decimal and percent conversions
- Simple probability
- Computation of central angles of a circle graph.

Student Outcomes:

Students will:

- work independently to complete tasks with the teacher acting as a consultant.
- display the probability in fraction form, and the probability as a percent.
- exhibit a circle graph of determining who has the best chance of being selected the winner of the trip to Adventure World Park.
- justify which of three tools they would use to simulate the drawing of the winner.
- write steps he/she followed to simulate the drawing of the prize winner.
- explain how Robert won the prize having a small percentage.

Materials/Resources/Printed Materials:

- Worksheets (Activities 1, 2, 3, 4)
- Protractor or Fraction Circle
- Ruler
- Calculator (optional)

Development/Procedures:

- Create a context for your students:

  The Booster's Club at William J. Clinton Middle School is selling candy bars to raise money needed to purchase graphing calculators for the 7th grade. As an incentive, the group has offered a trip to Adventure World for a student in each class to be determined randomly. Each student will receive one chance for every TEN candy bars sold. Your task is to predict the winner of the trip in Mrs. Louden's class.

- **Day 1** - The student will be asked to find the probability and compute the equivalent percentage in order to predict the outcome of the raffle. Students will be asked to complete Activity 1. This activity will require the student to predict the probability of each students' chance of winning the raffle using the given data. Students will then find equivalent percentages to complete the chart. The information gathered in the chart will be used to respond to assessment questions.

- **Day 2** - Students will use the percentage of probability to calculate central angles and construct a circle graph. The student will use the data from Activity 1 to complete Activity 2. In this activity, students will convert percentages to degrees of central angles and organize in chart format. Students will then use protractors and rulers to construct a circle graph using these values. Fraction circles may be used in place of protractors for students who have difficulty graphing central angles.

- **Day 3** - Students will be asked to simulate the outcome of the raffle and explain a given scenario using the information from the previous activities. In Activity 3, students will simulate the outcome of the raffle using the tool of their choice (Three options are given.). After explaining their reasoning, students will be asked to outline their method for choosing the winner. In Activity 4, a scenario will be given and students will be asked to explain the logic of how the student won using the principles from the previous activities.

Performance Assessment:

Students will be given a new scenario:

The Youth Group at your church is planning a weekend trip to a ski lodge with the price including transportation, accommodations, meals and slope time. You have been given the task to justify how a fund raiser could reduce the price of the trip. You will be expected to include charts, graphs and written justifications for your plan. Your efforts will be assessed using a rubric.

Extension/Follow Up:

Questions for further investigations:

- How could we change the scenario to make it more challenging?
- What suggestions could you make to the original task less of a challenge?
- Name at least two additional graphs you could have used to simulate the probability of winning the trip? Give detailed examples.

Have students collect the data of the other classes that participated in the candy sale.

Use plot functions on the TI-73 Graphing calculator to graph data to produce a circle graph. (Note: These calculators have limited capacity and will produce graphs with data for a maximum of 7 students.)

Authors:

Sean A. Kirkpatrick
Catonsville High School
Baltimore County, MD

Annette M. Brewer
Our Lady of Hope/St. Luke School
Archdiocese of Baltimore, MD

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Activity 1 - Step A

Mrs. Louden has designed a chart to post in the classroom to display everyone's chance of winning. Complete the chart below. State each probability in fraction form and the equivalent percentage. (1 point for each correct line)

Name	Number of bars sold	Number of chances in raffle	Probability of winning	Percentage
Michaela	30			
Robert	10			
Heather	40			
Trisha	50			
Kristy	15			
Adam	30			
Tony	25			
Matt	2			
Nicole	43			
Pat	20			
Total				

Activity 1 - Step B

Use the information on the chart to answer the following:

a. Who will most likely win the prize in the class? Why?_____

_____

_____ (1 point)

b. What are Michaela's chances of winning the prize? _____ (1 point)

Of not winning the prize? _____ (1 point)

c. How many candy bars would a student have to sell in order for them to have nine chances to win? _____ (1 point)

d. Look at Matt's probability of winning. Explain what it means. _____

_____

_____ (1 point)

Activity 2 - Step A

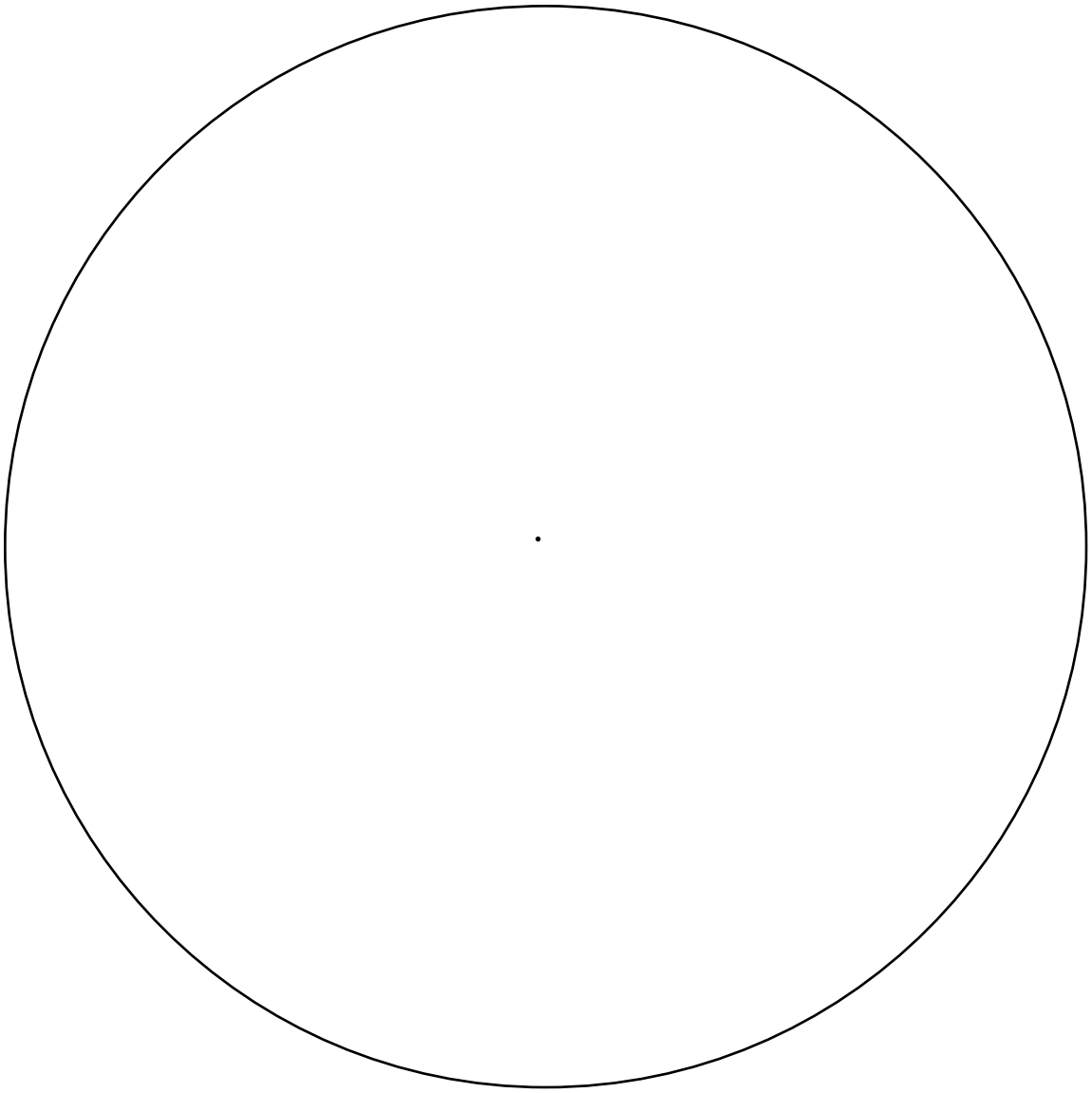
Copy the percentages from the chart in Activity 1 - Step A. Use the percentages to find the number of degrees in each central angle in order to complete the circle graph. (1 pt. for each correct central angle)

Name	Probability Percentage	Degrees in Central Angles
Michaela		
Robert		
Heather		
Trisha		
Kristy		
Adam		
Tony		
Matt		
Nicole		
Pat		
Total	100%	360°

Hint: Degrees in Central Angles = (percentage) x (360°).

Activity 2 - Step B

Draw a circle graph to compare the probability of each student winning the prize. Round to the nearest degree. (3 possible points)



Activity 3 - Step A

The class is impatient to find out who is going to win the drawing. Mrs. Louden asks if there is a way to simulate the raffle in advance to predict the winner. Which of the following do you think would be the most effective tool to use in this scenario. Circle your answer and explain your choice. (1 point)

COIN **DICE** **SPINNER**

Activity 3 - Step B

Write the steps you will follow to simulate the drawing of the prize winner. (2 points)

Activity 4

Finally, the day of the drawing arrives! Robert wins! Trisha is extremely surprised. It is your responsibility to explain to Trisha how this could happen. Use your experience with the simulation to explain how Robert won the contest. (2 points)

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Answer Key

The Booster's Club at William J. Clinton Middle School is selling candy bars to raise money needed to purchase graphing calculators for the 7th grade. As an incentive, the group has offered a trip to Adventure World for a student in each class to be determined randomly. Each student will receive one chance for every TEN candy bars sold. Your task is to predict the winner of the trip in Mrs. Louden's class.

Activity 1 - Step A

(10 possible points, 1 point for each correct line.)

This measures student ability to display the probability in fraction form, the probability as a percent, and determine the percent total of winning a prize.

Name	Number of bars sold	Number of chances in raffle	Probability of winning	Percentage
Michaela	30	3	3/25	12%
Robert	10	1	1/25	4%
Heather	40	4	4/25	16%
Trisha	50	5	5/25 or 1/5	20%
Kristy	15	1	1/25	4%
Adam	30	3	3/25	12%
Tony	25	2	2/25	8%
Matt	2	0	0/25	0%
Nicole	43	4	4/25	16%
Pat	20	2	2/25	8%
Total	265	25	25/25	100%

Activity 1- Step B

(5 possible points, 1 point for each correct response.)

This measures student ability to determine who is most likely to win a prize, determine their chances of winning a prize, and asses what Matt's probability means.

Activity 2 - Step A

(10 possible points, 1 point for each correct entry under degrees in central angles.)

This measures student ability to determine the degrees in central angles.

Copy the percentages from the chart in Activity 1 - Step A. Use the percentages to find the number of degrees in each central angle in order to complete the circle graph. (1 point for each correct central angle)

Name	Probability Percentage	Degrees in Central Angles
Michaela	12%	43.2°
Robert	4%	14.4°
Heather	16%	57.6°
Trisha	20%	72°
Kristy	4%	14.4°
Adam	12%	43.2°
Tony	8%	28.8°
Matt	0%	0°
Nicole	16%	57.6°
Pat	8%	28.8°
Total	100%	360°

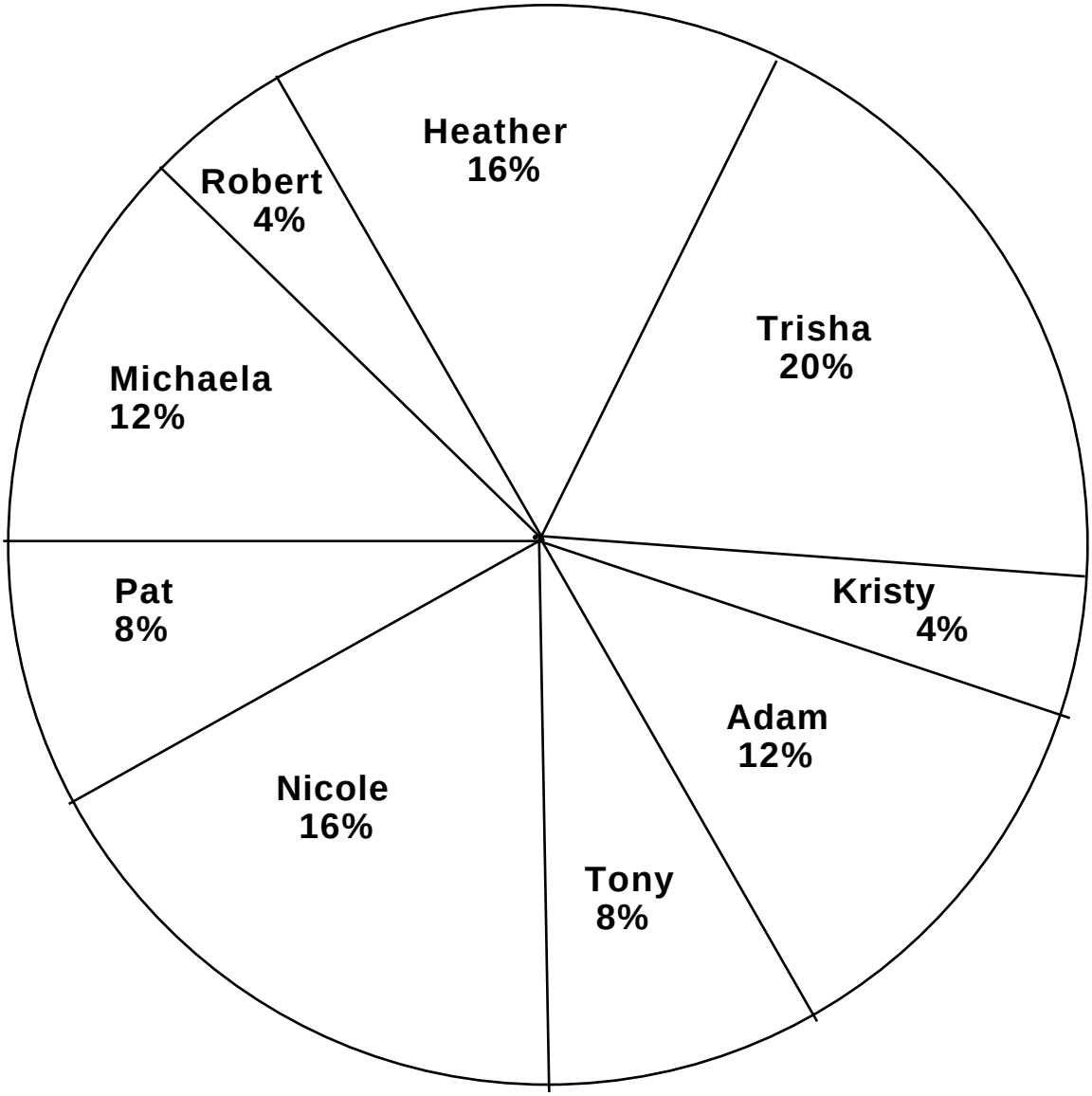
Hint: Degrees in Central Angles = (percentage) x (360°).

Activity 2 -Step B

(3 possible points)

3 points	•Correct angles, correctly labeled with names.
2 points	•Correct angles, correctly labeled with names or percents.
1 point	•Generally correct, but missing labels or error in central angles.

This measures student ability to exhibit a circle graph of determining who has the best chance of being selected the winner of the trip to Adventure World Park.



Activity 3 - Step A

(2 possible points)

1 point •Circled the word, SPINNER
1 point •Reasonable explanation of why this tool would be the best choice.

This measures student ability to justify which of three tools they would use to simulate the drawing of the winner.

Activity 3 - Step B

(2 possible points)

2 points •Complete detailed explanation.
•Construct a spinner designed like the circle graph in Activity 2, Step B.
•Conduct 100 or more trials.
•Record data in frequency table.
•Calculate the probability of each.
•Select the student with the highest probability as a winner.
1 point •Demonstrating good understanding of process but steps are unclear.

This measures student ability to write steps he/she followed to simulate the drawing of the prize winner.

Activity 4

(2 possible points)

2 points •Explains that a simulation is a mathematical experience that only approximates the real world.
•During the simulation, Trisha should win many more times than Robert.
•But Robert still has a chance and could win as he does.
1 point •Unsupported vague answer. Such as: It only takes one ticket to win.

This measures student ability to explain how Robert won the prize having a small probability/percentage.

The total point value is 33 points.

Performance Assessment Rubric

After completing the scenario, students will be awarded the following points for work completed.

Point Value	Task Completed
4	• Student has included all necessary charts and graphs outlining their plan. • Student has included a written justification effectively arguing the merits of their plan. • Calculations are correct and data used is valid. • Written language is understandable to the reader and proofread for errors.
3	• Student has completed the activity including at least 1 chart or graph in their presentation. • Student has a written justification for their proposal with an incomplete argument. • Calculations are correct and data used is valid. • Written language is understandable to the reader and proofread for errors.
2	• Student has completed the activity displaying one chart with some error. • Student has a written justification for their proposal with little of no argument. • Calculations are incorrect and / or data is invalid. • Written language includes errors.
1	• Student has completed either a chart or a written justification with various problems including calculations and /or written language.
0	• Student did not attempt the project.